years he constantly used his equatorial and transit. Several years before his death he vested these instruments in trustees for the benefit of the city of Liverpool; they were originally mounted at the Nautical Academy in Colquitt Street, and when the Corporation erected a Technical Institute they were transferred to suitable mountings on the roof of that building.

In 1893 Mr. Rylands published privately a handsome volume entitled *The Geography of Ptolemy Elucidated* (University Press, Dublin), in which by careful investigations he seeks to establish and demonstrate, by beautiful diagrams, a higher degree of accuracy in Ptolemy's writings than he had been previously credited with. A copy of the work is in the Library of the Society, presented by the author.

Mr. Rylands bequeathed to the University Library, Liverpool, a large number of books containing MSS. and early printed works, of which a Catalogue has just been printed at the Liverpool University Press. In the Preface to the Catalogue Principal Dale says :—"The collection is the most valuable that we have yet received in any single gift."

He was a good Greek and Latin scholar and an able mathematician, and possessed a fair knowledge of architecture, heraldry and ancient geography. He was a Justice of the Peace for Warrington and Mayor of Warrington 1858–59.

He was married twice, and leaves a widow, two sons and a daughter.

He was elected a Fellow of this Society on the 12th of January 1866.

The father of the late CHARLES PIAZZI SMYTH, the well-known Admiral Smyth, spent the early years of his married life on the Mediterranean Station. At Palermo he made the acquaintance of the venerable Italian astronomer, Giuseppe Piazzi. The Admiral and his wife (Annarella, daughter of T. Warington, Esq., of Naples), who is still remembered as "a lady of great ability and rare accomplishments," were so much interested in the studies of their distinguished friend that they named their second son, who was born at Naples on the 3rd of January 1819, Charles Piazzi Smyth. The celebrated astronomer acted as godfather, and at the christening expressed the desire that the child might become an astronomer. When the boy was about eleven years old his father, who had settled at Bedford, bought what was then considered a powerful telescope, and erected the well-known Bedford Observatory. One can easily imagine with what enthusiasm the Admiral pointed out the various constellations to his clever children and taught them the rudiments of astronomy, for, besides Charles, there were two sons and several daughters. The eldest son, Sir Warington Smyth, became Professor of Mineralogy at the Royal School of Mines. The third son is General Sir Henry Smyth. One of the daughters married Sir William Flower, late Director of the Natural

History Museum, South Kensington; another, who is mentioned as the special companion of the Admiral, died before her parents; while yet another daughter is Mrs. Baden-Powell, mother of the hero of Mafeking.

At the age of ten years we find Piazzi Smyth a pupil at the Bedford Grammar School, which he left when he was sixteen and went to the Cape as assistant to Mr. (afterwards Sir Thomas) Maclear. The way in which he at once assisted Maclear in observing Halley's Comet, and, in particular, his characteristic drawings of the comet published in *R.A.S. Memoirs*, vol. x., show how much he had profited by his home training in astronomy and astronomical drawing. In 1843 he made a series of observations of the great Comet of that year, extending from 5th March to 19th April with a $3\frac{1}{2}$-inch portable telescope, which seems to have been the largest instrument then available at the Cape for extra-meridional observations. He also depicted in oils the appearance of the great Comet as seen in the late evening twilight, with its slender and somewhat plumed tail stretching far up into the sky.

Apart from sharing in the routine work of the Observatory, he took a particularly active part in the Verification and Extension of La Caille's Arc of Meridian, which had been preceded by an interesting triangulation for connecting La Caille's Observatory, the modern Observatory, and Sir John Herschel's large Reflecting Telescope. He also shared in the measurement of the Zwartland Base, which lasted from 30th October 1840 until 5th April 1841, and which required the co-operation of no less than twenty-six persons. But several of these seem to have been frequently prostrated by sickness due to exposure to violent winds alternating with great heat.

In the triangulation Piazzi Smyth seems to have had a full share of work at the leftier stations, including Kamies-Sector Berg, 5141 feet high; Winter Berg, 6818 feet, occupied from July 9 to October 10, 1844, and mentioned by Maclear as "a difficult snow-capped mountain in the winter season"; and, lastly, Sneeuw Kop, 5211 feet, occupied from November 22, 1844, to July 21, 1845.

Piazzi Smyth then returned to the Observatory, preparatory to leaving the Cape for Edinburgh, where he had been appointed successor to Henderson as Astronomer Royal for Scotland and Professor of Practical Astronomy in the University of Edinburgh. But he delayed his departure for a time in order to facilitate the extension of the triangulation to Cape L'Agulhas, and did not sail for England until the 22nd October 1845. He carried with him the best wishes of Maclear, who speaks of him as "experienced in the details of meridian work, and unflinching in hardships," and adds that "he had a happy talent, with the assistance of his pencil, in conciliating the inhabitants, . . . and his robust constitution fitted him for taking an active share in the triangulation."

On arriving in Edinburgh he made it his first duty to complete the reductions of the observations accumulated by his predecessor, Thomas Henderson. In this work he was ably seconded by the late Alexander Wallace, who held the post of first assistant from the time of Henderson's appointment in 1834 until 1880. The collected results of these observations were eventually published in *Edinburgh Observations*, vols. xiv. and xv. When Piazzi Smyth commenced a further series of observations with the beautiful transit instrument used by his predecessor, he was at once confronted by a serious difficulty which had already been recognised by Henderson. This was the great susceptibility of the instrument to changes of temperature. After much skilful and patient observation, the disturbances were eventually traced in great part to the expansion and contraction of the regulating screws attached to the Y's. The adjustable Y's were discarded in 1848, and the stability of the instrument was thereby much increased. In 1851 Professor Smyth proceeded to Norway in company with Dr. T. R. Robinson, of Armagh, to observe a total eclipse of the Sun. Owing to clouds the eclipse itself was not seen; but, thanks to very complete preparations, Piazzi Smyth was able to make a number of sketches showing the various effects of light, shade, and colour incidental to the passage of the dark shadow of the Moon. Two of these sketches were reproduced in chromo-lithography in *Edinburgh Observations*, vol. xii., and Sir Robert Ball, in the *Story of the Sun*, also makes use of the Professor's unique sketches and verbal description to convey a vivid impression of the sudden darkness and the weird bordering of distant light, which are characteristic features even when the actual eclipse is hidden by clouds.

In 1856 Professor Smyth married Miss Jessie Duncan, who throughout the long period of forty years of their married life acted as his enthusiastic and indefatigable helpmate in all his work and accompanied him on all his journeys. In the same year Piazzi Smyth was in a position to carry out a long-cherished plan, viz. to undertake an astronomical expedition to the Peak of Teneriffe in search of Newton's "most serene and quiet Air, such as may perhaps be found on the tops of the highest Mountains above the grosser clouds." He fixed on this particular mountain on account of its being readily accessible in a fairly low latitude, and easy of ascent. In May 1856 the Admiralty entrusted him with a scientific mission to the Peak, placing 500*l.* at his disposal. At the same time Robert Stephenson, M.P., invited him to make use of his yacht "Titania" of 140 tons, for the whole time of the expedition. Preparations were pushed forward so eagerly that already in June Professor and Mrs. Smyth embarked in the "Titania." The chief instrument taken out was a beautiful and very complete equatorial of $7\frac{1}{4}$ inches aperture by T. Cooke & Sons, lent by Mr. Pattinson of Newcastle-upon-Tyne. The first station occupied in Teneriffe was the summit of Guajara at a height of 8900 feet on the

southern wall of the "crater of elevation," distant some five miles from the Peak itself. The Professor and his wife remained at Guajara from 14th July till 20th August. The experiences of camp life gained while engaged on the Cape geodetic operations here stood the party in good stead; hence, with the help of three "isleños" and a couple of men from the yacht a substantial temporary observatory was soon rigged up and the work of the expedition begun. From the very first Piazzi Smyth was delighted with the sharp definition and perfect steadiness of the stellar discs and their surrounding diffraction rings as shown in the 3·6-inch Sheepshanks equatorial from the Edinburgh Observatory; this in itself went far to prove that the "most serene and quiet air" did really exist "above the grosser clouds." A series of measures of the Moon's radiant heat was rewarded by an encouraging degree of success, confirming as they did the earlier experiments of Melloni by showing that the heat received from the full Moon was not altogether inappreciable. His examination of the solar spectrum at various hours of the day was conducted in such manner as to turn to the best advantage the unique conditions under which he worked. It was clearly recognised that the Fraunhofer lines were partly of solar and partly of terrestrial origin. The rapid increase in the number and blackness of the atmospheric lines as the Sun approached the horizon was carefully depicted in a series of drawings of the solar spectrum with the Sun at zenith distances ranging from 12° to 91°·1. The meteorological features of the region above the clouds were perseveringly studied with the hygrometer and black-bulb thermometer. Drawings were made of the lower cloud strata, while the "battle of the clouds" that heralded the breaking up of the summer season on the Peak was described with singular felicity. To bring out the diurnal phenomena more clearly recourse was had to the method of term-days introduced by Sir John Herschel. These observations were in part made simultaneously on board the yacht lying in Vera Cruz roads and on the summit of Guajara.

Though on the whole Piazzi Smyth had much reason to be satisfied with the work accomplished on Guajara, yet the dust-haze which from time to time impaired the clearness of the atmosphere made him wish to test the atmospheric conditions at a yet higher level. Accordingly on the 21st of August a move was made to Alta Vista, 10,700 feet above sea-level, where, after many difficulties had been overcome, the Pattinson equatorial was successfully installed on the 3rd of September at the highest point accessible to mules. The next afternoon the companion to *Antares* was seen twenty minutes before sunset, with powers of 160 to 500, both with direct and transparent-reflector eyepiece. At night the instrument was found to perform admirably on close double stars: concerning γ_2 *Andromedæ* the Professor writes "Duplicity of B, C at once apparent, powers 350 to 800; C is smaller than B; they are seen as two separate stars with a

dark line between them, though at the same time they somewhat compress each other's discs." *Jupiter*, then in good position, presented the magnificent spectacle so skilfully depicted in the well-known drawings published in *Edinburgh Observations*, vol. xii., and in *Phil. Trans.* for 1858. The many-sided genius of the Professor was strongly brought out on an excursion to the summit of the Peak. He gives a most interesting description of the various zones of lava streams, and fully accounts for the presence of a population of birds and insects in the terminal crater by the moisture due to steam given out by the volcano. The famed ice-cavern, from which the camp obtained their supply of water, was explored and described. The remarkable instance of lateral refraction recorded by Humboldt, which had been a puzzle to scientists for half a century, is discussed, and attention drawn suggestively to the fact that the observation was made in the neighbourhood of the well-known "narix" or blow-hole, where Smyth himself found the barometric readings to be altogether abnormal. Unfortunately autumn burst in on the observing party much earlier than was expected, and forced upon Piazzi Smyth the conviction that at a high level the seasons occur much more in accordance with the solstices than is the case at lower elevations. Accordingly this notable "Astronomer's Experiment" was concluded on the 19th of September. The results of the expedition were published in a *Report on the Teneriffe Astronomical Experiment of* 1856, *addressed to the Lords Commissioners of the Admiralty*, 4to, London and Edinburgh, 1858; and, with some omissions, in the *Phil. Trans.* for the same year; while much of the detail and certain enlarged photographs are included in vol. xii. of the *Edinburgh Observations*. These valuable photographs show the difference of the actinic transparency of the air at a height of 10,700 feet and at sea-level. In *Teneriffe, an Astronomer's Experiment: or, Specialities of a Residence above the Clouds*, 8vo. London, 1858, the general reader with astronomical tastes will find one of the most fascinating volumes ever written. Its interest and permanent value are much enhanced by the score of photo-stereographs with which it is illustrated.

A voyage to Russia by way of the Baltic was undertaken in 1859, an account of which is given in *Three Cities in Russia*, 2 vols. 8vo., London, 1862. Here, again, an additional charm is lent to the narrative by Smyth's own characteristic illustrations. The astronomer's interest in these volumes naturally centres in the description of the great Observatory at Pulkowa. The venerable designer of that famous establishment, W. von Struve, was unfortunately absent, but the honours of the place were most hospitably done by his son Otto and the distinguished staff of Associate Astronomers.

Our Inheritance in the Great Pyramid, a volume published in 1864, shows how much Piazzi Smyth's thoughts were at this time occupied with that wonderful monument; and it is there-

fore not surprising that we find Professor and Mrs. Smyth settled at Gizeh in the beginning of 1865. Here he measured the Great Pyramid as to its orientation, the size and slope of its great passages, and the dimensions of its inner chambers. The greatest care and accuracy were bestowed in finding the dimensions and cubic content of the sarcophagus in the King's Chamber. These investigations are discussed with much detail and illustrated by many plates in *Edinburgh Observations*, vol xiii., a volume which will always be regarded as a standard work of reference on the metrology of the Great Pyramid. The value of these measurements, and the skill with which they were made, were fully recognised by the Royal Society of Edinburgh, who awarded the Keith Prize to Professor Smyth in 1867. So much public interest had been aroused by these investigations that Piazzi Smyth was induced to issue a work of three volumes in a more popular form entitled *Life and Work at the Great Pyramid*, which was followed in 1868 by yet another volume *On the Antiquity of Intellectual Man, from a Practical and Astronomical point of View.* It is much to be regretted that these volumes are largely interspersed with mystical speculations to the great prejudice of their scientific value. Unfortunately this tendency displayed in his works on the Great Pyramid led to controversies with the Council of the Royal Society of London, which culminated in Piazzi Smyth's withdrawal from the Society in 1874.

Shortly afterwards the indefatigable Professor engrossed himself with Spectroscopy. He worked at the Solar Spectrum, the Spectra of Luminous Gases, of the Aurora, and of the Rain-band. The occasion of a visit to Palermo in the spring of 1872 had been utilised in making spectroscopic observations of the Zodiacal Light, the spectrum of which he found to resemble closely that of very feeble twilight (*Monthly Notices*, vol. xxxii. p. 277). Finding it practically impossible to study the Solar Spectrum to advantage in the smoky atmosphere of Edinburgh, we again see Piazzi Smyth in 1877 transport his instruments to a sunnier climate, which this time he found in Portugal. Here he addressed himself to an examination of the red end of the Solar Spectrum, and certainly made notable progress in the resolution of the great bands in that region into their constituent lines. His results were communicated to the Royal Society of Edinburgh and published in the twenty-ninth volume of their *Transactions*; and in 1880 he was awarded the Makdougall-Brisbane Prize for these researches. Four years later we see him start for Madeira, again in quest of sunshine. With improved apparatus, including a Rutherfurd grating with 17,296 lines to the inch, he succeeded in completely resolving many of the more difficult groups of lines in the visual spectrum of sunlight. The results of this excursion were given to the world in a handsome volume entitled *Madeira Spectroscopic*, 4to, Edinburgh, 1882. Piazzi Smyth's most detailed survey of the Solar Spectrum was accom-

plished in Winchester in the summer of 1884. The object of this work was partly to ascertain whether the great volcanic eruptions of 1883 had in any appreciable degree affected the absorptive power of the Earth's atmosphere. On this occasion the apparatus used was rendered more perfect by the addition of a magnificent Rowland grating. The outcome of this interesting survey appeared in a memoir, illustrated by sixty-one coloured plates, entitled "The Visual, Grating and Glass-lens Solar Spectrum (in 1884)," contained in vol. xxxii. Part II. of the *Edinburgh Transactions.*

In connection with his reseaches in Solar Spectroscopy he carried on an extensive series of laboratory investigations, in the course of which, in conjunction with Professor Alexander Herschel, he discovered the rhythmical relation between the chief lines of carbonic oxide gas. These remarks are set forth in the following papers: "End-on Illumination in Private Spectroscopy, and its Applications to both Blow-pipe Flames and Electric Illumined Gas-vacuum Tubes," 1879; "Carbon and Carbo-Hydrogen spectroscoped and spectrometed in 1879," and "Micrometrical Measures of Gaseous Spectra under High Dispersion," 1886.

In the hours of relaxation from his purely scientific labours Piazzi Smyth turned his inventive genius, with the same eagerness that characterised all he did, to the field of mechanical invention. A problem which long attracted his attention was the construction of a "free-revolver stand" on the principle of the gyroscope, for the steady support of scientific instruments at sea. An apparatus of this kind was tried with considerable success on the voyage to Teneriffe. Unfortunately the spinning motion had to be imparted by means of a rope pulled from time to time by the all-too-willing sailors: an important axle gave way just when the experiment seemed most promising. It is much to be regretted that this important invention has never been further developed. The excitement of the Crimean War turned the Professor's thoughts to the construction of a portable distance measurer. On his Russian journey he was alike surprised and delighted to find that a Russian astronomer had hit upon identically the same construction at the same exciting epoch. In 1852 an ingenious system was devised of signalling the time from the observatory on Calton Hill by means of a time-ball. This was supplemented in 1861 by a time-gun at Edinburgh Castle and the establishment of sympathetic clocks in various parts of the city. Eventually Dundee was included in the circuit. In this work he was ably assisted by James Ritchie & Son, the well-known Edinburgh clockmakers. To meteorology he made many important contributions, amongst which may be mentioned his discussion of the readings of the rock thermometers established on Calton Hill in 1837, in their relation to the sun spot period and the mean temperature of Scotland.

In 1888 Piazzi Smyth resigned his position as Director of the

Observatory and Professor in the University which he had held for forty-three years, and with his wife retired to a country house near Ripon, which was named Clova in remembrance of a place in Aberdeenshire where Mrs. Smyth had spent part of her life. Here he continued his work with unflagging zeal, photographing the Solar Spectrum on a large scale with the help of the Rowland grating; he also secured a beautiful series of photographs of typical cloud formations. After the Professor's death the negatives of these latter photographs were generously presented to the Edinburgh Royal Observatory by Mr. W. B. Dunlop of Edinburgh.

In 1896 Mrs. Smyth, the faithful and indefatigable sharer of all his labours, succumbed to a long and painful illness. After her death the Professor led even a more retired life than before, though still occupied with astronomical problems.

He died at Clova on the 21st of February 1900, and was buried beside his wife in the churchyard of Sharow, a parish some two miles distant from Clova.

On glancing back at Professor Piazzi Smyth's life, thus imperfectly sketched, one cannot but admire his indomitable energy and activity and the great versatility of his mind. He was a keen observer of Nature, and thanks to his skill alike with pen and pencil he succeeded in interesting a world-wide circle of readers in the objects in which he himself was interested. His contributions to sidereal astronomy, to mountain astronomy—to which he gave an impetus that cannot be over-estimated—and especially to spectroscopy will always secure him a high place amongst the scientific workers of the Victorian era. Though he was of a retiring disposition, those who came in contact with Piazzi Smyth were attracted by the gentle amiability of his manner and by his readiness to impart full particulars of the investigation on which he happened to be engaged.

Professor Smyth was a Corresponding Member of the Academies of Science of Munich and Palermo, and a Fellow of the Royal Societies of London and Edinburgh. He received the honorary degree of LL.D. from the University of Edinburgh, and was elected Fellow of this Society as far back as 1846.

R. C.

JAMES HENRY YOUNG, a son of the late Captain J. H. Young of Jersey, was born at Gorey, Jersey, on the 23rd of January 1858. He was educated at the Victoria College, Jersey, and at the age of 18 entered the Civil Service in the Office of Works, in which appointment he continued up to the time of his sudden death on the 24th of September, 1900. He married in 1879 Miss Mildred E. C. Jerrold (a granddaughter of Douglas Jerrold), and leaves five children. He graduated as B.Sc. at the London University in 1892. He was accustomed to public lecturing, some of the titles chosen being "Star-myths and what has become of them," "Sun-spots," "The Earth's Future," "Sixty